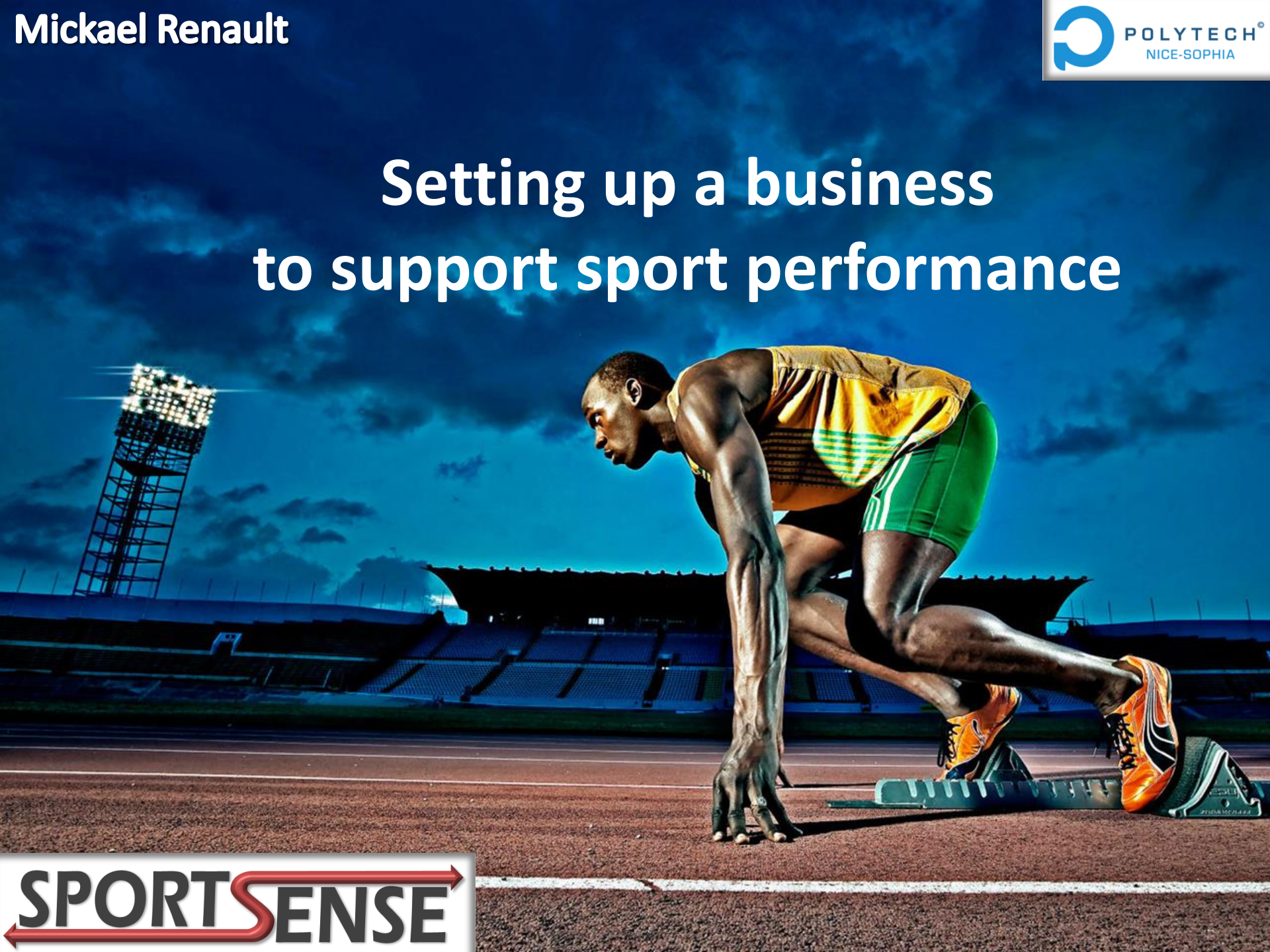
Mickael Renault

POLYTECH NICE-SOPHIA

Setting up a business to support sport performance



SPORTSENSE

Table of content

Introduction

Introduction

An unusual internship

- More students interested in entrepreneurship and project management
- Will to create, to bring new solutions

- Internship agreement with the University to **work on my own project**
- **No technical supervision, own resources**

How can electronics engineering students challenge themselves to start an entrepreneurship?

I) Context, mission and goal

A. Context

***APCE** (Entrepreneurship Information Agency) :*

- In 10 years, young entrepreneurship (by -30) has almost **tripled**
- **48%** of 18-25 students think about setting up their own business
  → only **1%** of them do it
- Why? **80%** discouraged by the economic context

Political will :

- 29 Innovation and Entrepreneurship Units (Universities)
  → Give support and help linking students to companies and associations
- Student Entrepreneur status for -28 : created in 2014
  → Conciliate education system with entrepreneurship
  → Target : 20 000 Student Entrepreneur within 2017

B. Student Entrepreneur

Possibilities of the status :

- Support and coaching by teachers or professionals
  → Give tools and advices to start
  → Follow the project and help focusing on essential tasks
- Substitution of regular internship by entrepreneurship experience
  → Technical internship or undergraduate internship
- Provide a place in a business incubator or a coworking space
- Entrepreneur Student Diploma :
  → Management and commercial courses
  → Certification of experience

C. My project

Triple project environment :

- High level athlete in trampoline since 2007 in the French Team since 2013
  - → Needs in the sports : traditional training based on repetition
    Efficiency problem
  - → Needs of precision, data mining and analysis
    The coach can't see everything
  - → Needs of self-confrontation to realize better performances
- Electronic cursus in Polytech'Nice Sophia : Embedded Systems
- Enthusiastic about piloting project, startup environment
  - → Application to the Student Entrepreneur status

C. My project

Project topic :

- Designing an **innovative product to support sport performance** (training and competition)
  → Measuring performance : height, distance, strength, position, speed, rotation, heart rate, aerodynamics
  → Analyzing data : data-mining, technical and chronological evaluation
  → User rendering : show the results and the progression
- Adapt product to **constrained environment**
  → Subaquatic, autonomy, real-time, portability
- **Affordable**
  → Equip small sport structure to improve global level

II) Setting up a business

A. Method of work

Lean Process :

- **Define** — Define the problem
- **Measure** — Measure the lack, its environment and its potential
- **Analyze** — Analyze data to determine root causes
- **Improve** — Improve the process – Implement the solution
- **Control** — Control the process

Step	Define	Measure	Analyze	Improve	Control
Project Plan	■				
Environment Analysis	■	■			
Customer needs/review		■			■
Customer approach (gain)		■			
Capability Analysis		■	■		■
Multi-variable Studies		■	■		
System approach			■	■	
Design and test			■	■	
Control Plans		■			■

B. Market and environment

- Clubs, CREPS (Regional Sport Unit), INSEP (National Elite Sport Unit), Sports Federations

- Any level : 15 M license holders → 172 000 sport associations
  Competition : 4 M competitors (26%) → 105 000 sport association (61%)
  High Level : 15 000 HL athletes → 513 Excellence Units

- Nature of founds (depends on the structure) :
  → Local, regional, or national grant
  → Membership fee
  France allows grant for public interest projects (i.e. sport equipment)

C. Follow the needs

Real questions of the needs :

- What does the customer really need and why ?
  → Lack of actual situation
- In which context would he use the product ?
  → Constraints
- What is his interests ?
  → Return on investment : time, efficiency, effort
- Who needs, who buys?
  → Find the right interlocutor for each step of development

C. Follow the needs

3 examples :

Patrice Béhague, *Antibes' CREPS director*

« Optimize work sequence to improve efficiency and reduce workload. »

Yoann Berteotti, *Sophrologist, mental coach*

« Self-confrontation is an engine of progress in high performance sport. »

Christophe Lambert, *Gym Federation President*

« National level will improve if every single club gives the athletes the feeling of working like a champion. »

D. Action plan

Refine business activity :

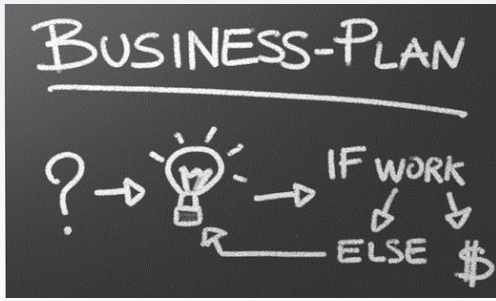
- Connected sensors (force, height, movement, position)
- Video analysis
- Data storage and backup
- Statistics rendering (once or chronologically)
- Individual workout, physical preparation, rest and nutrition programs

Forecasted earnings (Business Plan) :

- Depend on the costs analysis → no existing estimations

How to evaluate ?

Need to build a prototype



D. Action plan

Building a prototype :

- Own design and production instead of subcontracting
- Electronic device prototype with own funds

Benefit from French Team Member position :

- Knowing the real need of displacement analysis machine
  (new judgement method in 2017)
- Good potential on the trampoline market
  Target : 100 clubs, 600€/p → Turnover : 60 000€
- First customer : France Trampoline Center

Pôle France
ANTIBES
TRAMPOLINE – GYM ACRO

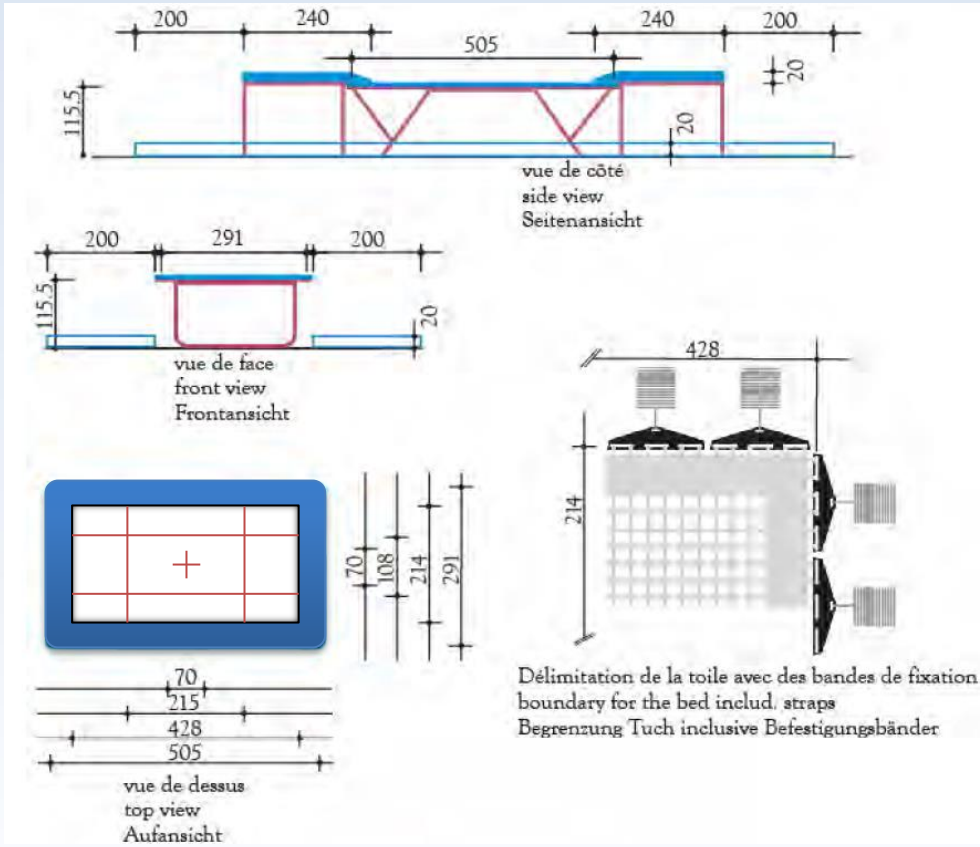
III) Prototype and technical part

A. Requirements

Major functional specifications :

- Time Of Flight measurement
- Displacement measurement
- Synchronization measurement

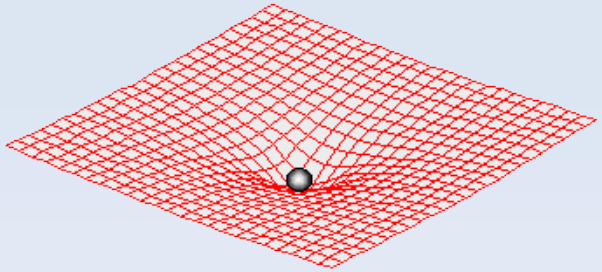
- At least 10 jumps record
- User Interface
- “ForgotToStart” function
- Jump-by-jump analysis
- Save records

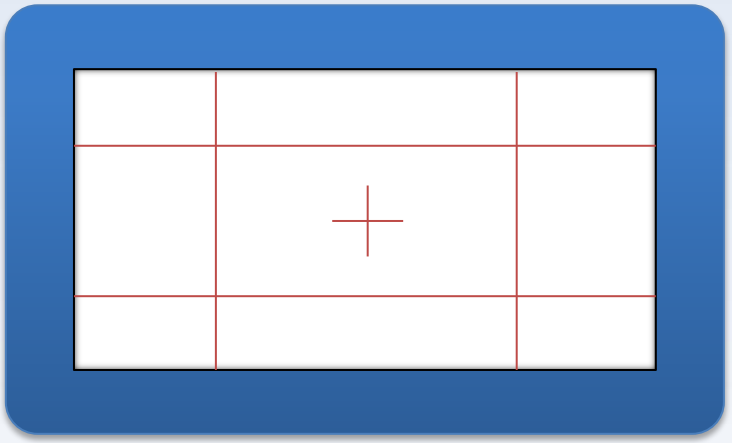


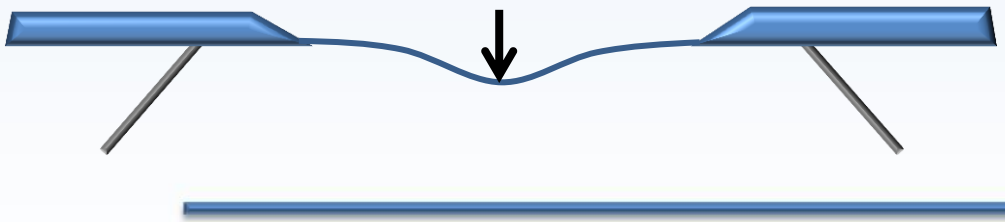
A. Requirements

Constraints :

- 1ms accuracy for TOF
- 5cm accuracy for position
- Reach 5,83m wide detection (sensors)
- Limited sinking duration on the web
- All position measures at the same time



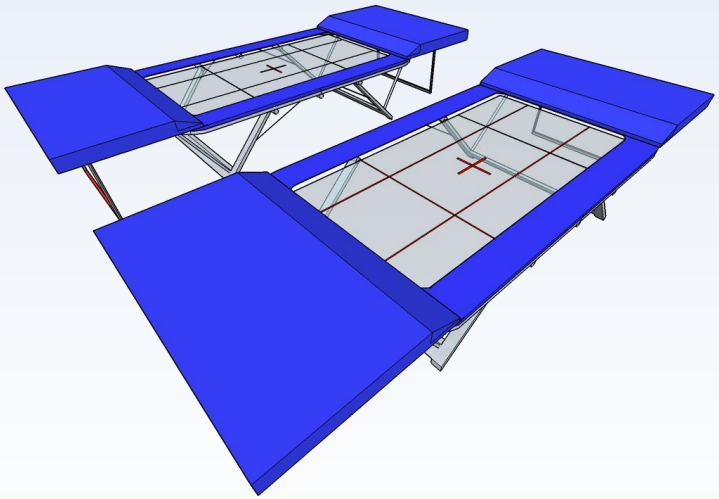




B. Modelling and refining

Method of work :

1. Environment modelling, constraints understanding
2. Functional delimitation
3. Successively refine functional solution (model choice, then each block)
4. Technology exploration and choices
5. Technical implementation
6. Tests and validation
7. Costs Analysis

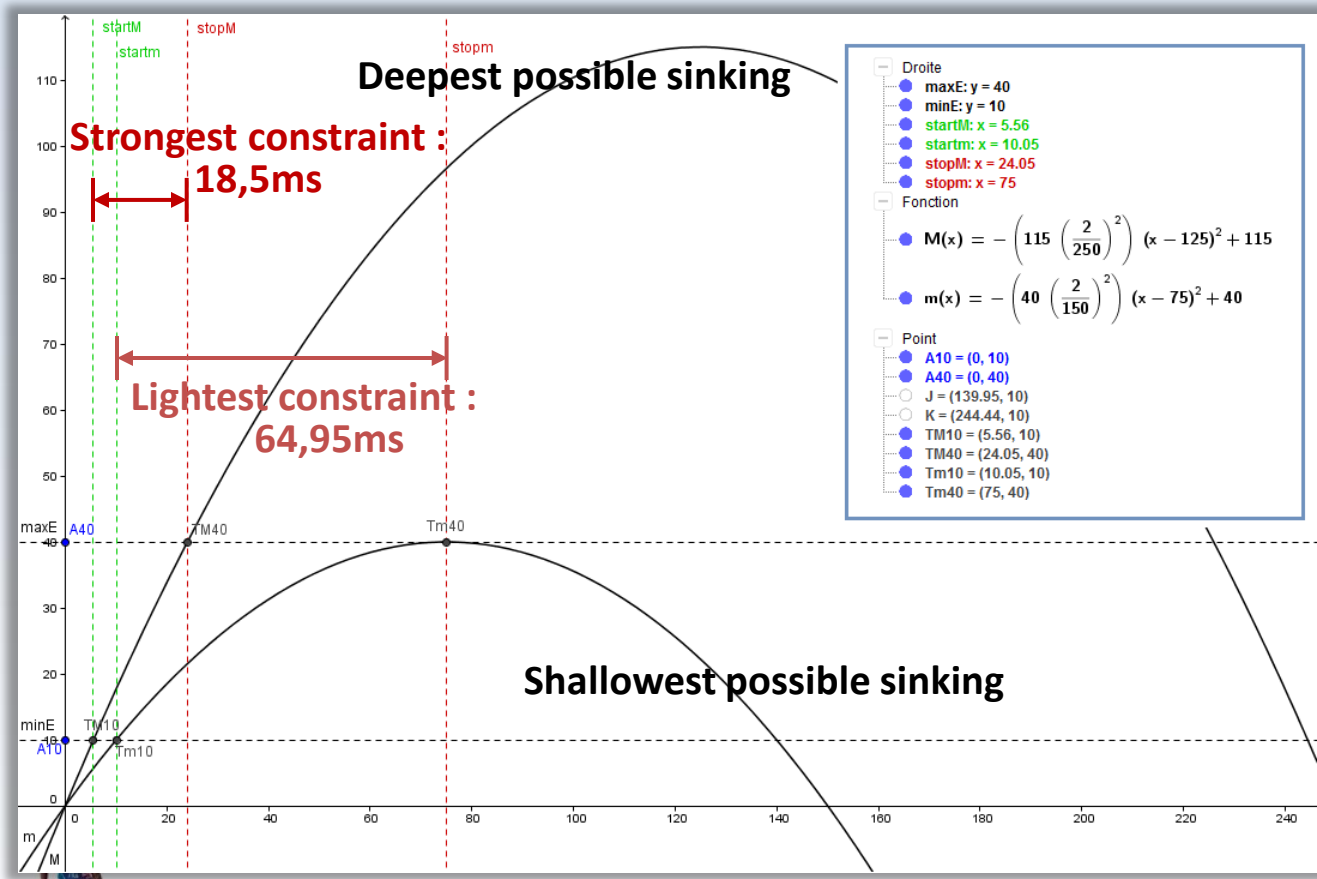


B. Modelling and refining

Environment :

- Detection at **10cm** (norms)
- Latest position measure at **40cm**

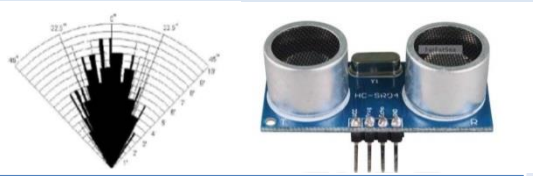
Time constraint between detection and position signal :
18,5ms



Minimal and maximal sinking curves along time

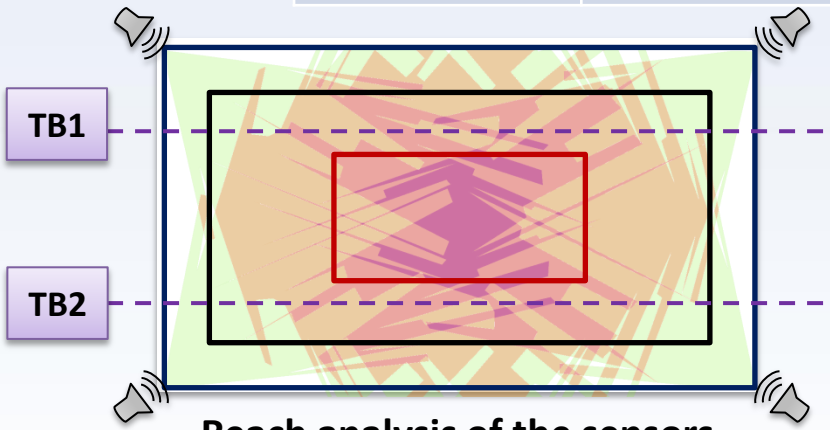
B. Modelling and refining

Sensor modelling :



Ultrasonic Ranging Module HCSR04 Specifications	
Working Voltage	DC 5 V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
Measuring Angle	15 degree
Trigger Input Signal	10µS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in proportion
Dimension	45*20*15mm

LG-JG20MA Specifications	
Sense distance	0-20m
Sense method	through beam
Work voltage	DC4.5V-5.5V
Work current	<50mA
Output	NPN normally open / 100 mA
Send angle	direct line
Receive angle	< 5deg
Response Time	2ms
Work temperature	-25°C to 50°C
Dimension	20*10*10mm
Cable length	50cm



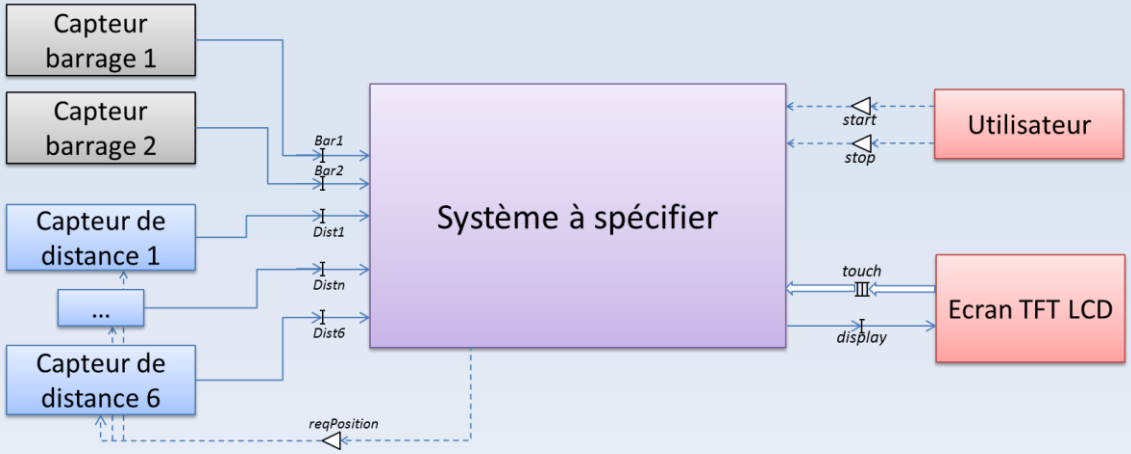
Reach analysis of the sensors

B. Modelling and refining

Global diagrams :

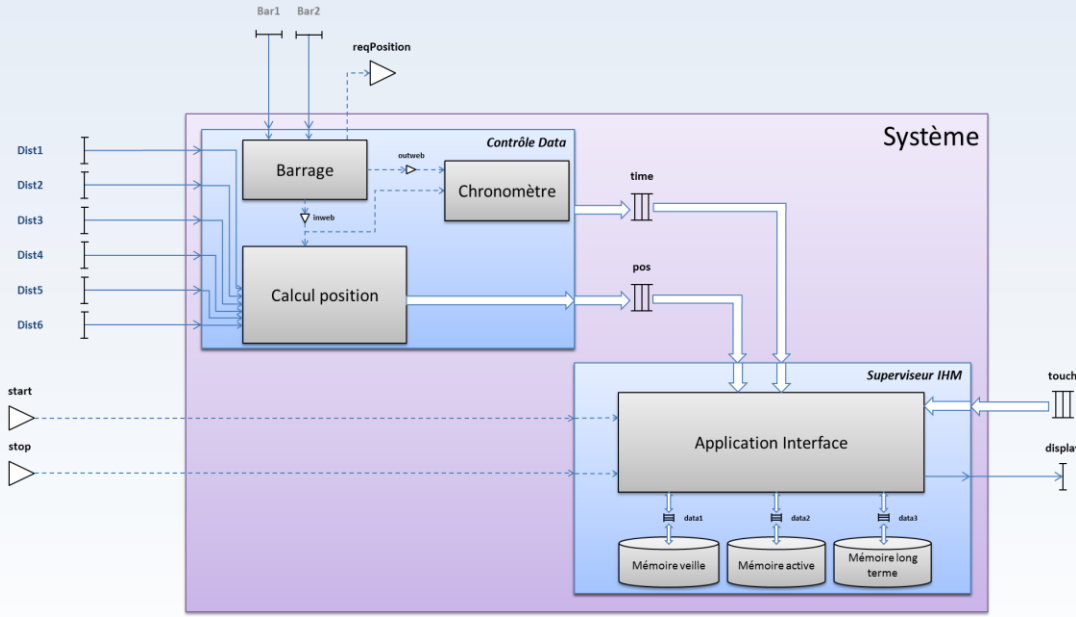
External elements :

- 2 Through-Beam Sensors
- 4 Range Sensors
- TFT Screen
- 2 Push Buttons



Control/Supervision Model :

- Controller calculates position and TOF
- Supervisor collects data and render results and interact with users

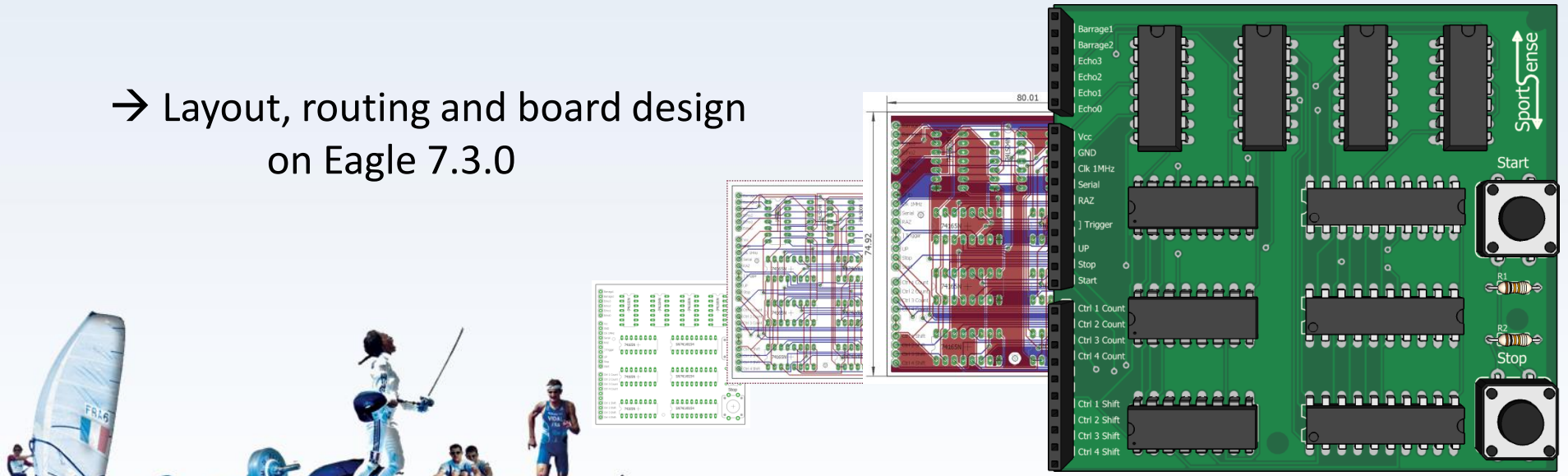


C. Implementation

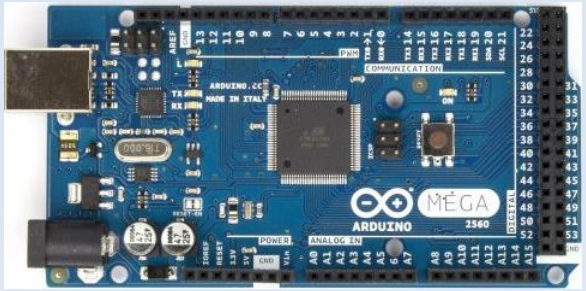
Serialization (sensor to controller) :

- Simultaneous data from sensor → parallelism one-shot
- Buffering and serialization with logical components :
  → dual 16bits counters SN74LV8154, and 8bits shift register CD74HC165
- Adequate logical gate (And, Or, Not, LatchD)

→ Layout, routing and board design
on Eagle 7.3.0



C. Implementation

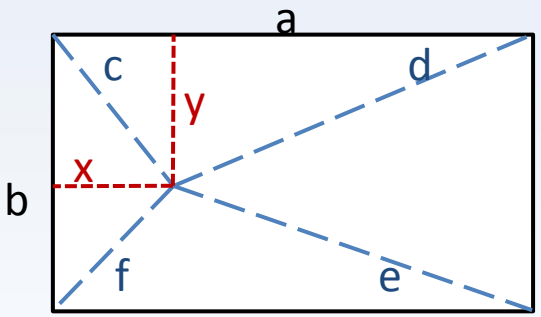


Data computation :

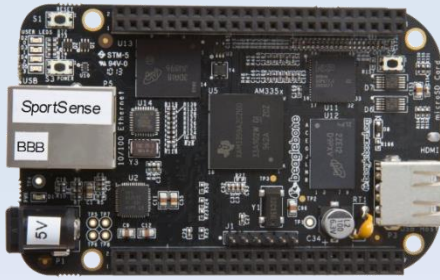
- Simple Arduino Mega2560
- Deliver 1MHz clock by configuring Timer registers
- Control counters mode and shift registers
- Receive sensors data → calculate TOF and position

$$\begin{cases} c^2 = x^2 + y^2 \\ d^2 = (a-x)^2 + y^2 \\ e^2 = (a-x)^2 + (b-y)^2 \\ f^2 = x^2 + (b-y)^2 \end{cases} \Rightarrow \begin{cases} \begin{cases} x_1 = \sqrt{c^2 - {y_1}^2} \\ (b-y_1)^2 = (c^2 - {y_1}^2) \end{cases} \Rightarrow \begin{cases} y_1 = \dfrac{b^2 + c^2 - f^2}{2b} \\ x_1 = \sqrt{c^2 - {y_1}^2} \end{cases} \\ \begin{cases} a - x_2 = \sqrt{d^2 - {y_1}^2} \\ (b-y_2)^2 = (d^2 - {y_2}^2) \end{cases} \Rightarrow \begin{cases} y_2 = \dfrac{b^2 + d^2 - e^2}{2b} \\ x_2 = a - \sqrt{d^2 - {y_2}^2} \end{cases} \end{cases}$$

$$\Rightarrow \begin{cases} x = \dfrac{x_1 + x_2}{2} \\ y = \dfrac{y_1 + y_2}{2} \end{cases}$$



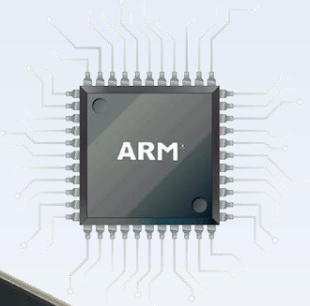
C. Implementation

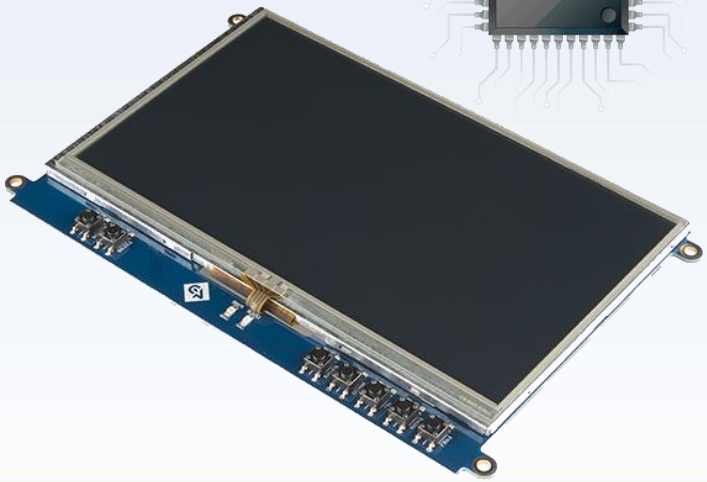


Graphical User Interface (GUI) :

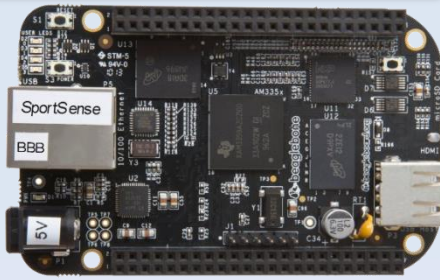
- Supervisor system : BeagleBone Black
- QML : Qt Meta Language → based on JavaScript, C++ integrated
- Declarative language for design and interaction :
  - → 1 file = 1 page
  - → touch input, fluid animations (60 FPS)
  - → signal input, memory management
- Displayed on TFT LCD 7” screen
  - → Compile directly on BBB
  - → Cross-compile for ARM from laptop

debian



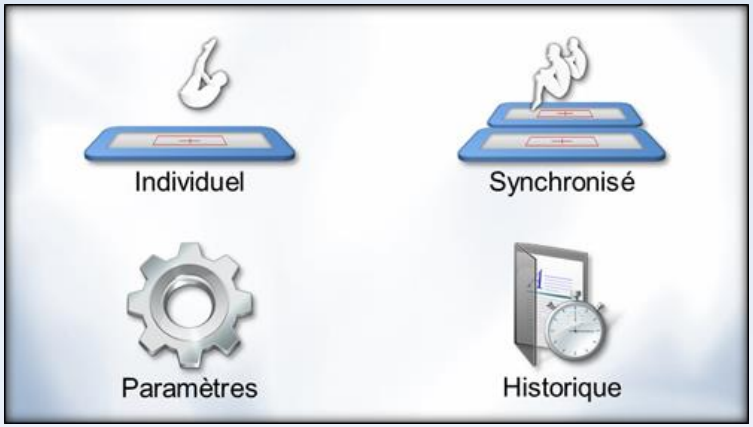


C. Implementation

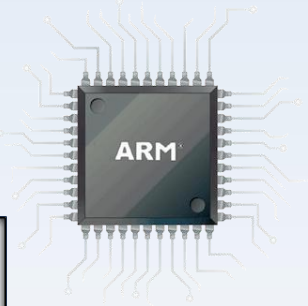


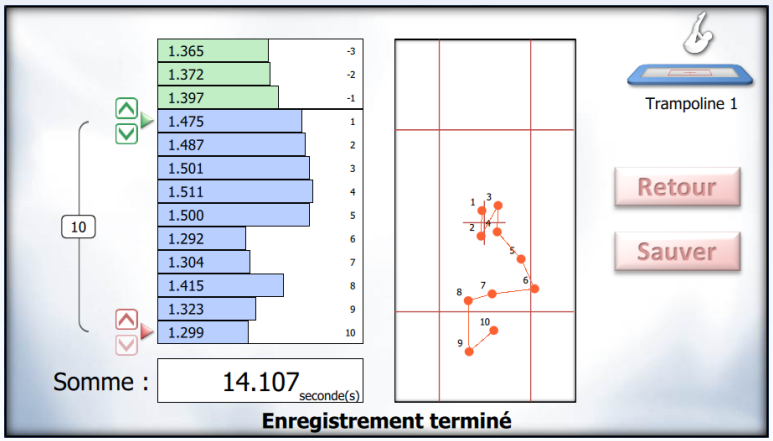
Graphical User Interface (GUI) :

Quick example…



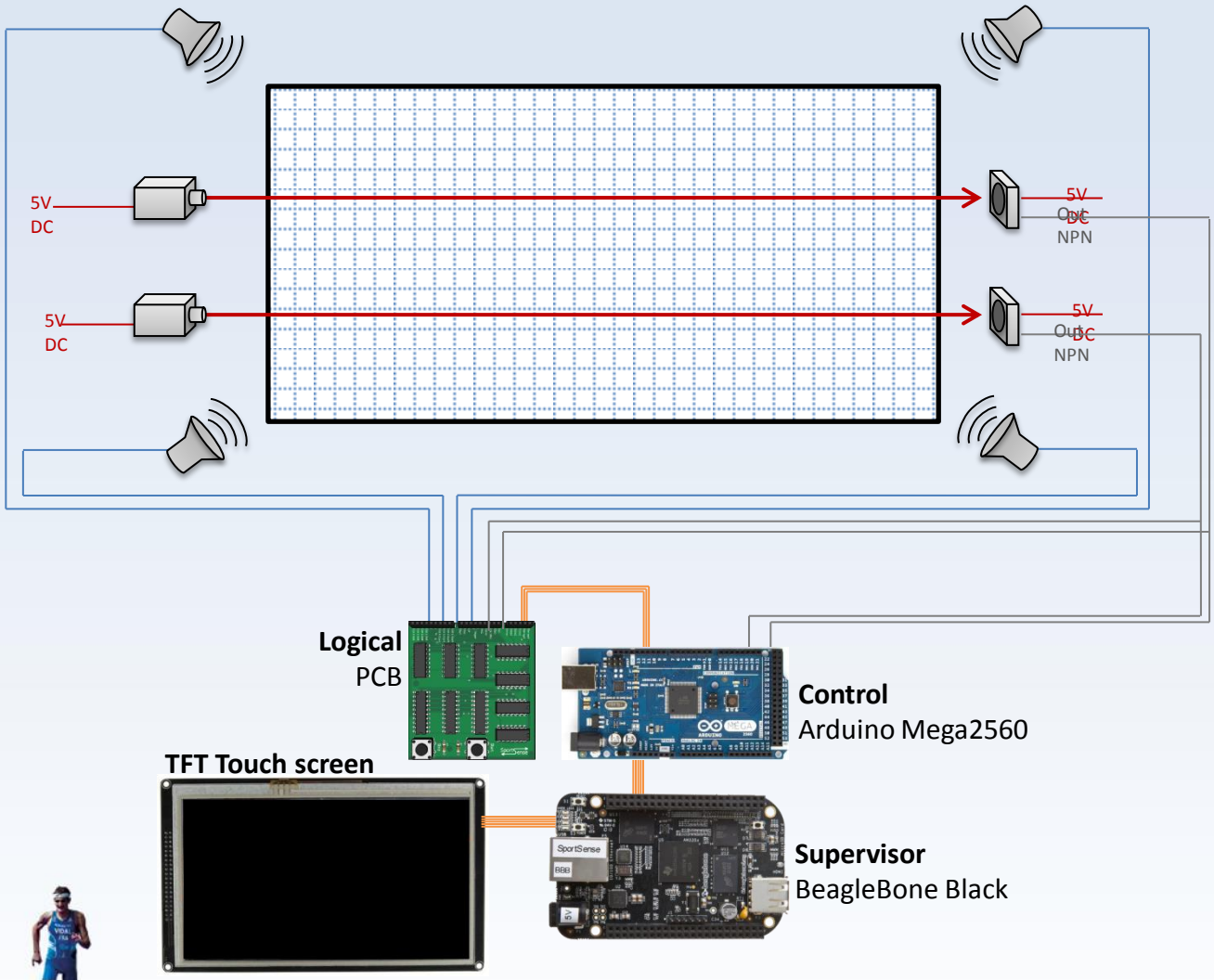
debian





C. Implementation

Global overview :



IV) Review and future directions

A. Benefits of this experience

Better vision of entrepreneurship :

Working on problems : "To fill a need, understand the need"

→ Entrepreneur study the lack and its environment
→ Engineer works on solution
→ Salesman sell the product

Setting up a business : not a quiet long river

- Understanding market and needs
- Finding support and resources
- Building projected balance sheet, including profit-and-loss account
- Building prototype and viability review

A. Benefits of this experience

Better vision of fields of electronics :

Working on logic design :

- Hardware solution to time constraints
- Serialization process

Working on User Interface :

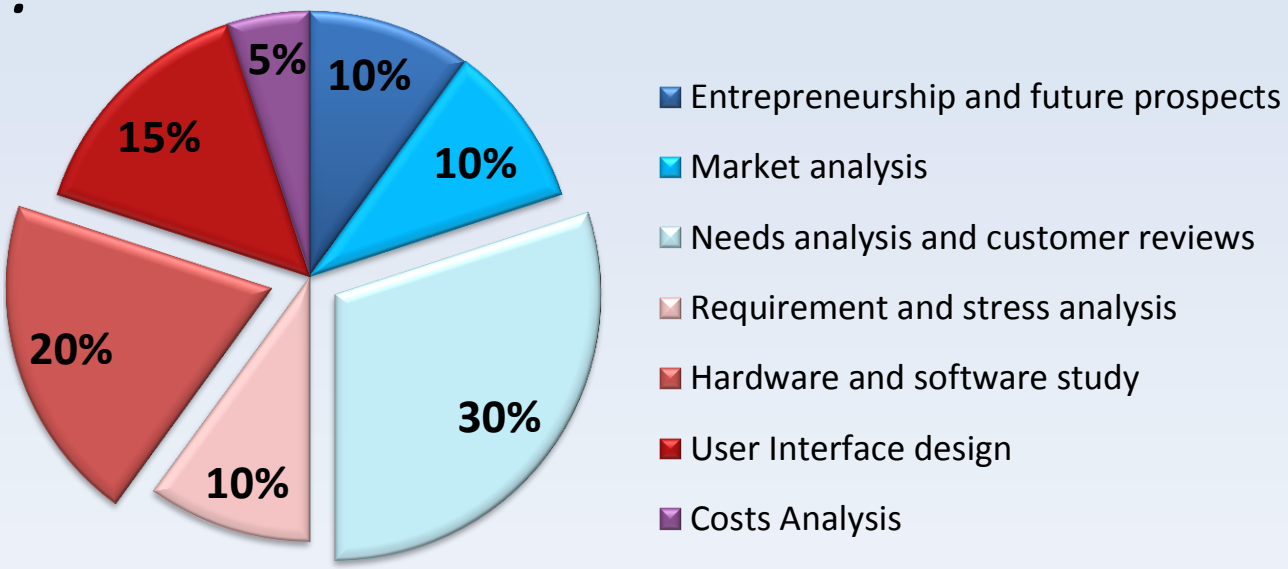
- User oriented approach (ergonomics)
- QML declarative language

Working on some amateur materials :

- Cheap way to understand a professional product
- Use existing elements instead of recreate (time to market)
- Register config. and cross-compile, just like professional product

A. Benefits of this experience

Versatility :



Fields and time distribution along the project

Continuous self-training and reconsideration :
"One step down, two steps up"

B. Future directions

Testing :

- Test in a realistic environment
- Improve model
- Debug

Costs Analysis :

- Ask for a personalized quotation
- Viability Analysis
- Business Plan with forecasted earnings

Conclusion

Conclusion

Global approach :

- Understanding the company's way of thinking
- Necessity to evaluate the needs, the market and the potential

Customer approach :

- Understanding the use, return on investment, expected quality-price ratio
- Ergonomic shape

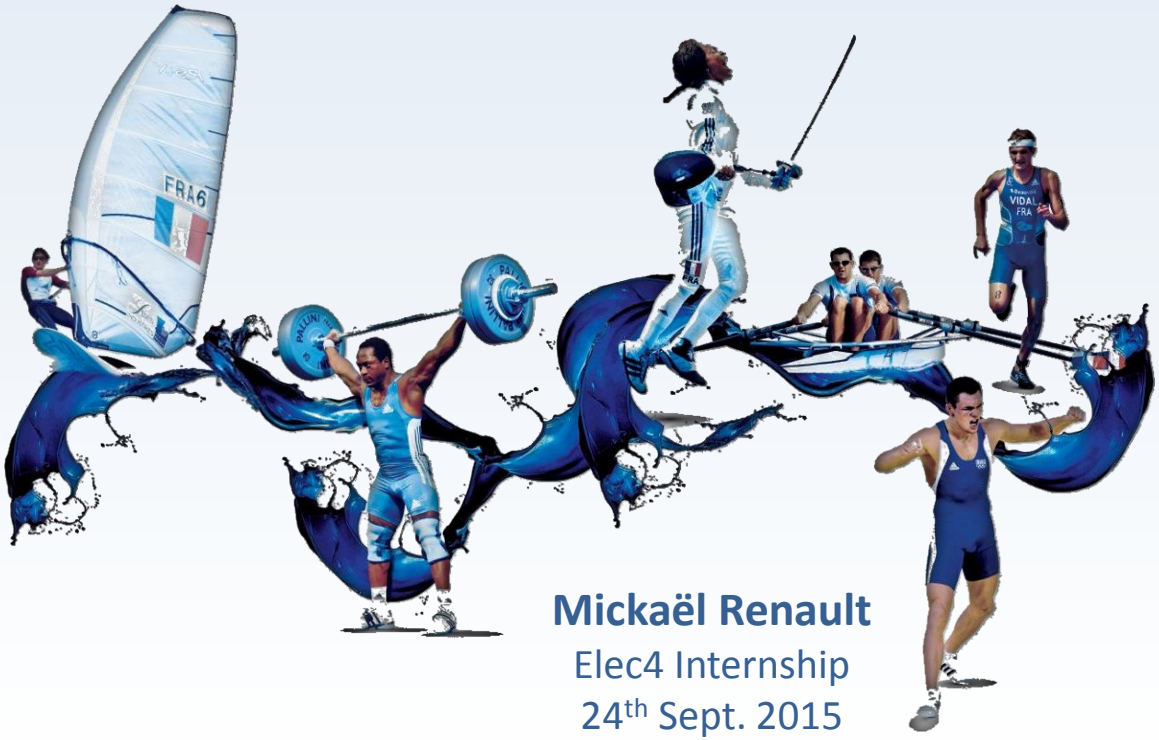
System approach :

- Constraint analysis
- System modelling and refining
- Implementation, test and debug

The diversity of working areas is absorbing, but teaches how to organize, work with lucidity, and overcome difficulties.

Thanks for your attention

Do you have any questions ?



Mickaël Renault
Elec4 Internship
24th Sept. 2015